



Survivability of Collective Protection Systems Subjected to Air Blast Loads



**2003 Joint Service Scientific Conference on
Chemical & Biological Defense Research**

November 2003

**Robert Dinan & John Hawk
Air Force Research Laboratory
Materials & Manufacturing
Directorate/Force Protection
Branch (MLQF)
Tyndall AFB
(850)283-3605, DSN 523-3605**

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 19 NOV 2003		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Survivability of Collective Protection Systems Subjected to Air Blast Loads				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials & Manufacturing Directorate/Force Protection Branch (MLQF) Tyndall AFB				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM001851, Proceedings of the 2003 Joint Service Scientific Conference on Chemical & Biological Defense Research, 17-20 November 2003. , The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 12	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Survivability of Collective Protection Systems Subjected to Air Blast Loads



Tests conducted by the Air Force Research Laboratory (AFRL) and the USAF Force Protection Battlelab demonstrated that M28 liners installed in Tent Extendable Modular Personnel (TEMPER) tents ripped, separated at the zip connections, and failed to maintain pressure when subjected to blast loading by a satchel-sized explosive charge at standoff distances of 100 feet or more, while the parent tents suffered little or no damage at a standoff distance of 65 feet.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



The M28 Collective Protection (CP) System is essentially a polyethylene liner used in TEMPER and other rigid frame tents. A filtered ventilation system supplies toxin free air to the liner and maintains a positive pressure slightly greater than the surrounding atmospheric pressure that ensures that the flow of air through small holes or loose seals is outward to prevent flow of contaminated air into the protective system. The TEMPER tent itself consists of a canvas material draped over a frame and staked to the ground.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



The M28 liner system consists of 16 foot center sections, end sections, and entry vestibules that are joined by airtight zip-type seals.



Plastic straps with arrowhead type connectors riveted to the outside of the M28 liner attach to the tent frame to support the liner when it is not inflated by the ventilation system.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



A tent fitted with the M28 collective protection system (CPS) allows personnel inside the shelter to work, eat or rest without the burden of individual protective equipment. However, this advantage is nullified if the liner has a breach so large that the ventilation system is unable to maintain positive pressure and outward air flow, as through a large tear or failure of a zip seal.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



A satchel sized explosive device placed about 100 feet from TEMPER tents fitted with the M28 CPS did only minor damage to the tent and frame. Damage consisted primarily of stakes pulled from the ground and loosened tension lines.





Survivability of Collective Protection Systems Subjected to Air Blast Loads



The same satchel sized explosive device caused zip-seals in the M28 liner to separate, and resulted in a complete loss of positive pressure inside the liner.





Survivability of Collective Protection Systems Subjected to Air Blast Loads



Tears in the liner also contributed to the complete loss of overpressure inside the M28 liner after the explosive blast.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



Tears are probably a result of the point stresses created where the arrowhead anchoring straps attach to the liner; as the liner is compressed by the pressure wave the anchor straps constrain the liner's motion.

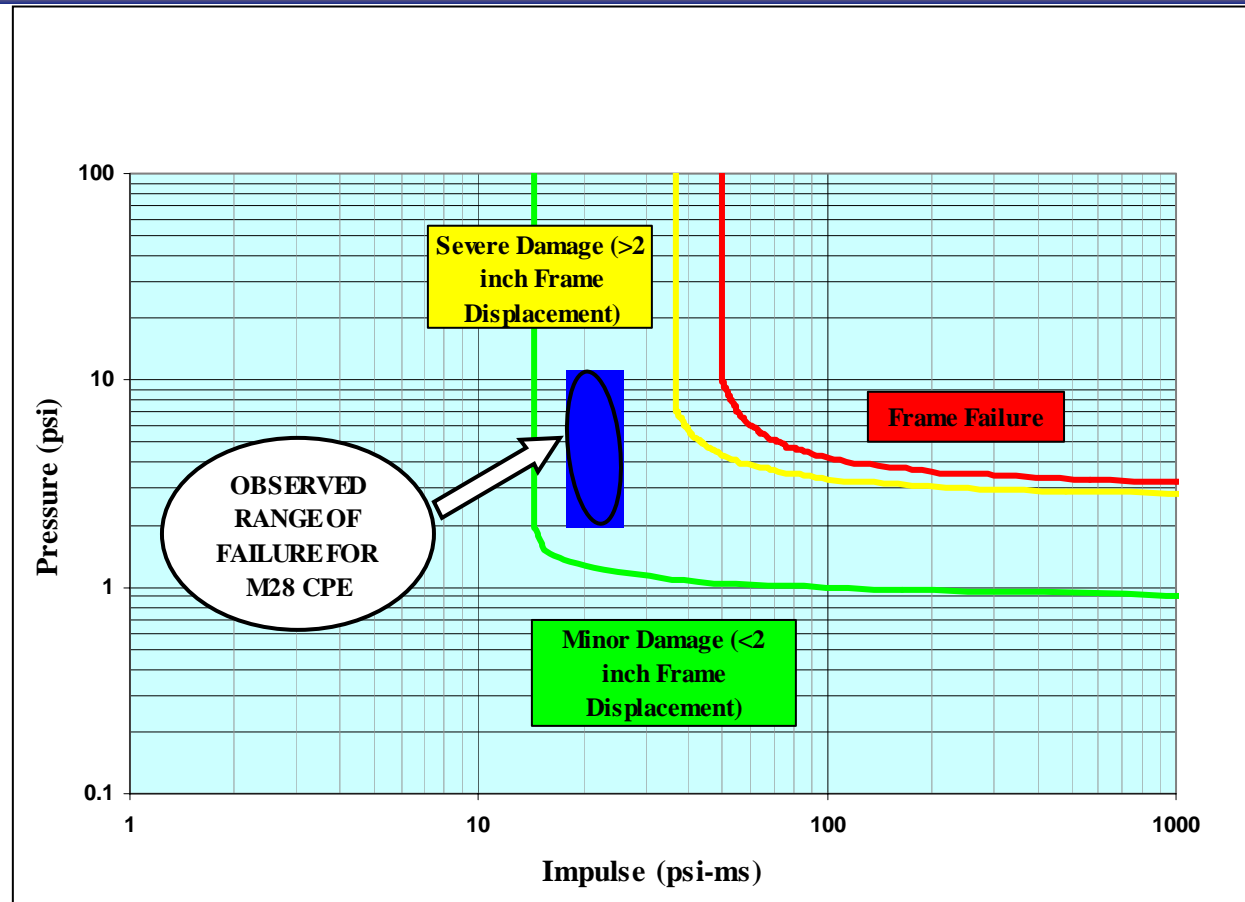


Failure of the seals is likely due to the unequal distribution of pressure on the front and back side of the structure.





Survivability of Collective Protection Systems Subjected to Air Blast Loads



Data from tests on TEMPER tents with the M28 CPS highlights a significant shortcoming of the M28 liner; the survivability of the liner to air blast is not well balanced with the survivability of the parent tent.



Survivability of Collective Protection Systems Subjected to Air Blast Loads



- Partners at Virginia Tech are developing a computer model of the TEMPER-M28 system capable of predicting the response of the shelter to dynamic loads. Field tests are being conducted at AFRL to measure the response of the system to actual blast loads.
- The goal is to create a software model that can be used to analyze other soft-sided shelter systems, including future CPS designs, and to identify remedies to improve blast survivability of the existing TEMPER-M28 shelter.





Survivability of Collective Protection Systems Subjected to Air Blast Loads



- Collaborators
 - USAF Force Protection Battlelab
 - U.S. Army Soldier Systems Command
 - Virginia Polytechnic Institute and State University
 - Production Products Mfg. (manufacturer of the M28 liner)